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Machine learning-assisted measurement of multi-differential lepton-jet correlations in deep-inelastic scattering with the H1 detector

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The lepton-jet momentum imbalance in deep inelastic scattering events offers a useful set of observables for unifying collinear and transverse-momentum-dependent frameworks for describing high energy Quantum Chromodynamics interactions. A recent first measurement was made [1] of this imbalance in the laboratory frame using positron-proton collision data recordedf with the H1 experiment at HERA in the years 2006-2007. Using a new machine learning method, the measurement was performed simultaneously and unbinned in eight dimensions. The first results were presented as a set of four one-dimensional projections onto key observables. This work extends over those results by making use of the multi-differential nature of the unfolded result. In particular, distributions of lepton-jet correlation observables are studied as a function of the kinematic properties of the scattering process, i.e. as a function of the momentum transfer $Q^2 > 150$ GeV^2 and the inelasticity $0.2 < y < 0.7$.

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[1] PRL 128 (2022), 132002 [arxiv:2108.12376]

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